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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 09/821,753
Filing Date: March 30, 2001
Appellant(s): NI ET AL.

Allan M. Lowe
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed 1/22/08 and 7/9/08 and the reply brief filed on 1/13/09 appealing from the Office action mailed 8/23/07.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

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The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

No amendment after final has been filed.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is substantially correct. The changes are as follows:

NEW GROUND(S) OF REJECTION

Claims 47-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chao et al., US 2002/0106845.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

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US 2002/0106845	CHAO et al.	08-2002
US 6,051,503	BHARDWAJ et al.	04-2000
WO 00/58992	HOWALD et al.	10-2000

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 47-66 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification, as originally filed, does not provide support for "the AC etchant plasma always being the dominant material applied to the workpiece while the feature is being formed" as claimed in claim 47-lines 3-5 and claim 59-lines 9-10. Furthermore, it appears that using a deposition gas with an etching gas is taught in paragraph 0030 of the instant application.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 38-46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chao et al., US 2002/0106845.

Chao et al. shows the invention substantially as claimed including a method of forming a rounded corner of a trench of a workpiece in a vacuum plasma chamber, comprising converting a gas species that is supplied to the chamber into an etchant plasma that is continuously applied to the workpiece while the rounded corner is being formed, and changing the power applied to the etchant plasma while the rounded corner is being formed (see paragraphs 0048-0049 and fig. 4D).

Chao et al. does not expressly disclose gradually changing the power applied to the etchant plasma such that the power does not remain constant for durations in excess of one second and at the same time maintaining constant the pressure in the chamber, the flow rate in the chamber, and the species flowing into the chamber. However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to determine through routine experimentation the manner in which the power is changed and whether the pressure, flow rate, or species flowing into the chamber is constant or changed based upon a variety of factors including the desired profile of the corner and such limitation would not lend patentability to the instant application absent a showing of unexpected results.

With respect to claims 38-39 and 43-44, note that the etchant gas is the dominant gas and the rounded corner is at an intersection of a wall of the trench and a surface intersecting the wall, the surface extending generally at right angles to the wall.

Concerning the amount the power is changed, it would have been obvious to one of ordinary skill in the art at the time the invention was made to determine through routine experimentation the optimum

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amount of time at which the power should remain constant and the optimum amount the power is changed, to achieve the desired rounded profile of the trench and such limitations would not lend patentability to the instant application absent a showing of unexpected results.

Claims 47-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bhardwaj et al., U.S. Patent 6,051,503 in view of Howald et al., WO 00/58992.

Bhardwaj et al. shows the process substantially as claimed including a method of etching a workpiece in a vacuum plasma processor chamber comprising converting a gas species into an AC etchant plasma that is applied to the workpiece while a desired shape of the workpiece is being formed, the AC etchant plasma always being the dominant material applied to the workpiece while the desired shape of the workpiece (for example, a portion of the sidewall of the trench) is being formed, the vacuum chamber being subject to operating at different pressures while the workpiece is being processed (see abstract), the gas species being subject to flowing into the chamber at different flow rates while the workpiece is being processed (also see abstract), gradually changing, the amount of AC power supplied to the plasma during etching of the workpiece to form a desired shape (see col. 6-lines 43-47 and abstract), wherein a gradual transition in the shape of material in the workpiece being processed occurs in response to the gradual power change, the gradual power change occurring during the gradual transition in the shape of the material that has a desired shape (see abstract, col. 6-lines 43-49, col. 8-line 57 to col. 9-line 26, and figs. 19A-19B). Note that inherently a gradual power change will also produce a rounded profile in Bhardwaj et al. since the gradual power change in the instant application similarly produces a rounded profile.

Bhardwaj et al. fails to expressly disclose: wherein the gradual change is pre-programmed (use of a computer program). Howald et al. discloses a method of processing by etching (see page 1-lines 15-19) a workpiece in a vacuum plasma processor chamber including computers 20 and 34 and wherein a gas species is converted into an AC plasma (see page 6-lines 17-20). In view of this disclosure, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the process of Bhardwaj et al. so as to include a process using the apparatus of Howald et al. because such

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an apparatus allows for a high level of control over the plasma process being performed. Moreover, with respect to the changes in power being pre-programmed, it would have been obvious to one of ordinary skill in the art at the time the invention was made to pre-program the power change into the microprocessors 20,34 of Howald et al. because in such a way operator error will be eliminated. Moreover, merely using a computer to automate a known process does not by itself impart nonobviousness to the invention. See *Dann v. Johnston*, 425 U.S. 219, 227-30, 189 USPQ 257, 261 (1976); *In re Venner*, 262 F.2d 91, 95, 120 USPQ 193, 194 (CCPA 1958).

With respect to claims 49 and 61, note that the process can be conducted while no change is made in the species, the pressure, or the flow rate since the abstract of Bhardwaj et al. states only one or more of the parameters need to be changed.

Concerning claims 50-53 and 62-64, note that in Bhardwaj et al. the species is ionized into a plasma that etches the material to form the feature, the gradual power change (see abstract and col. 6-lines 43-49), the species, and the continuous application of the plasma to the workpiece being such that the material is shaped to have a rounded corner that includes the formed feature, which includes a trench wall having a lower rounded corner, in response to changes in the plasma etchant resulting from the gradual power change (note that by gradually changing the power the corner of the trench will be rounded similarly as in the instant application).

With respect to claims 54-58 and 65-66 concerning the specific time period to which the power remains at constant wattage and the amount the power is changed, it would have been obvious to one of ordinary skill in the art at the time the invention was made to determine through routine experimentation the optimum amount of time at which the power should remain constant and the optimum amount the power is changed, to achieve the desired rounded profile of the trench and such limitations would not lend patentability to the instant application absent a showing of unexpected results.

NEW GROUND(S) OF REJECTION

Claims 47-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chao et al., US 2002/0106845.

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Chao et al. shows the process substantially as claimed including a method of etching a workpiece in a vacuum plasma processor chamber comprising converting a gas species into an AC etchant plasma that is applied to the workpiece while a desired shape of the workpiece is being formed, the AC etchant plasma always being the dominant material applied to the workpiece while the desired shape of the workpiece (rounded corner) is being formed, the vacuum chamber being subject to operating at different pressures while the workpiece is being processed, the gas species being subject to flowing into the chamber at different flow rates while the workpiece is being processed, gradually changing, the amount of AC power supplied to the plasma during etching of the workpiece to form the desired shape, wherein a gradual transition in the shape of material in the workpiece being processed occurs in response to the gradual power change, the gradual power change occurring during the gradual transition in the shape of the material that has a desired shape (see, for example, paragraphs 0048-0049, and fig. 4D). Note that in response to gradually changing the power, inherently the gradual transition in the shape of the material in the workpiece (the rounded corner) occurs. Furthermore, Chao et al. discloses that the etching process can be pre-programmed in a computer program 190 which is executed by computer 160/162 (see, for example, paragraphs 0030-0035, and figures 2A-2B).

With respect to claims 49 and 61, note that the process can be conducted while no change is made in one of the species, the pressure, or the flow rate since only one or more of the parameters need to be changed. Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to determine through routine experimentation the optimum characteristics of the process (change or maintained constant one or more of the flow rate, the pressure and the gas species) based upon a variety of factors including the desired profile of the corner and such limitation would not lend patentability to the instant application absent a showing of unexpected results

Concerning claims 50-53 and 62-64, note that in Chao et al. the species is ionized into a plasma that etches the material to form the feature, the gradual power change; the species, and the continuous application of the plasma to the workpiece being such that the material is shaped to have a rounded corner that includes the formed feature, which includes a trench wall having a lower rounded corner, in response to changes in the plasma etchant resulting from the gradual power change.

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With respect to claims 54-58 and 65-66 concerning the specific time period to which the power remains at constant wattage and the amount the power is changed, it would have been obvious to one of ordinary skill in the art at the time the invention was made to determine through routine experimentation the optimum amount of time at which the power should remain constant and the optimum amount the power is changed, based upon a variety of factors including the desired rounded/shape profile of the trench and such limitations would not lend patentability to the instant application absent a showing of unexpected results.

(10) Response to Argument

Appellant argues that the rejection of claims 47-66 under 35 U.S.C. 112 first paragraph is improper because the referenced sections in the specification together with the statements provided in the declaration of inventor Andrew D. Bailey, Ph.D. provide support for the claimed limitation. The examiner respectfully disagrees with such an argument and contends that the specification does not provide support for the limitation because the specification (page 15-line 8 to page 17-line 25) discloses more than one etching step for forming the feature and it is disclose that the etchant plasma will **always** be the dominant material applied to the workpiece in all of the etching steps. Note that the portion of the specification that both the remarks and the declaration refers to are **only** directed to the last/final etching step of the feature. Concerning the declaration filed under 37 CFR 1.132, Mr. Bailey states that there is support in the specification of the instant application for "the AC etchant plasma always being the dominant material applied to the workpiece...". However, the examiner respectfully submits that there is no written description for the absolute limitation of the etchant material **always** being the dominant material since clearly the rounded corners can be formed if the etchant material is not the dominant material one hundred percent of the time

Appellant argues with respect to the rejection of claims 38-44 under 35 USC 103 that Chao does not disclose changing the power while the rounded corner is being formed. However, the reference clearly discloses the relationship between rounding the trench corners and increasing the power (see paragraph 0049). Furthermore, it would have been obvious to one of ordinary skill in the art at the time

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the invention was made to determine through routine experimentation the optimum amount of time at which the power should remain constant and the optimum amount the power is changed, to achieve the desired rounded profile of the trench and such limitations would not lend patentability to the instant application absent a showing of unexpected results. Clearly, changing or not changing parameters such as the pressure, flow rate, or power would be part of the process of routine experimentation.

Appellant argues that Chao et al. does not expressly disclose gradually changing the power applied to the etchant plasma while the rounded corner is being formed and therefore it does not make obvious the power duration requirement (the power does not remain constant for durations in excess of one second). However, it would have been obvious to one of ordinary skill in the art at the time the invention was made to determine through routine experimentation the manner in which the power is changed (power duration) based upon a variety of factors including the desired profile of the corner and such limitation would not lend patentability to the instant application absent a showing of unexpected results.

Appellant argues that Chao et al. requires a soft etch to the workpiece after the bottom corner has been rounded and that the claimed invention does not require such a step. The examiner respectfully contends that a) the open language of the claim does not limit the invention to only the claimed steps and therefore process that include additional steps not mentioned in the claims can also read on the claimed invention; and b) it is noted that the features upon which applicant relies (i.e., performing the process without using a soft etch step) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Regarding the declaration under 37 CFR 1.132 of Mr. Kamp, note that the claims are not commensurate in scope with the attempted showing of unexpected results. For example, the claims do not state that a soft etch is not required after the rounding of the trench corners.

Appellant argues with respect to the Bhardwaj et al. reference that there is no basis in the reference that the desired shape is not a portion of the wall of a trench. However, the examiner respectfully points out that the "desired shape" limitation of the claim is broad enough that when given its

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broadest reasonable interpretation it can read on a portion of the wall of the trench since there is no specific desired shape.

Appellant argues that the process in the Bhardwaj et al. reference includes alternating etching and deposition steps. However, the examiner respectfully contends that a) the open language of the claim does not limit the invention to only the claimed steps and therefore process that include additional steps not mentioned in the claims can also read on the claimed invention; and b) it should be noted that the features upon which applicant relies (i.e., the process not including a deposition step) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Appellant argues that in the process disclosed by the Bhardwaj et al. reference the claimed feature is not formed by the etching plasma always being applied to the workpiece. However, the examiner respectfully contends that a) the open language of the claim does not limit the feature to a specific structure and therefore the portion of the trench that is formed/processed when an etching step is performed can be read as the claimed feature; b) it should be noted that the features upon which applicant relies (i.e., the claimed feature being formed only by the etchant gas) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Appellant argues that in the Bhardwaj et al. reference the claimed rounding of the corners is not inherently expected to occur because the reference does not disclose an AC etchant plasma always being the dominant material applied to the workpiece while the desired shape is being formed. The examiner respectfully reiterates that: a) the "desired shape" limitation of the claim is broad enough that when given its broadest reasonable interpretation it can read on the portion of the wall of the trench that is being formed when the etching step is being performed, since there is no specific desired shape being claimed; b) the etchant plasma will be the dominant material applied to the workpiece while the "desired

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shape” is being formed while the etching step is being performed on the workpiece. Furthermore, note the new grounds of rejection with respect to claims 47-66 using the Chao et al. reference.

With respect to appellant’s argument concerning the statements in the declaration of Mr. Bailey that the Bhardwaj et al. reference does not show the etchant plasma being the dominant material, the examiner submits that if the feature formed is taken to be a portion of the wall of the trench then clearly this limitation is shown

With respect to appellant’s arguments with respect to claims 48-50, 52, 60-62, and 64, the examiner respectfully reiterates that: a) the “desired shape” limitation of the claim is broad enough that when given its broadest reasonable interpretation it can read on the portion of the wall of the trench that is being formed when the etching step is being performed , since there is no specific desired shape being claimed; b) the etchant plasma will be the dominant material applied to the workpiece while the "desired shape” is being formed while the etching step is being performed on the workpiece; and c) the term “curved” in the phrase “curved material” is a relative term that when given the claim its broadest reasonable interpretation the feature formed in the Bhardwaj et al. reference reads on it. Furthermore, note the new grounds of rejection with respect to claims 47-66 using the Chao et al. reference.

With respect to appellant’ arguments regarding the specific time period to which the power remains at constant wattage and the amount the power is changed, it would have been obvious to one of ordinary skill in the art at the time the invention was made to determine through routine experimentation, the manner in which the power is changed (power duration) and the optimum amount of time at which the power should remain constant and the optimum amount the power is changed, based upon a variety of factors including the desired rounded/shape profile of the trench and such limitations would not lend patentability to the instant application absent a showing of unexpected results.

Appellant’s arguments with respect to the new grounds of rejection using the Chao reference have been considered but are not deemed persuasive. Regarding appellant’s argument that the limitations of independent claim 59 have not been specifically addressed, note that the Chao reference clearly discloses the use of a processor-based system controller (see fig. 2B) which clearly would allow a

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stored signal to control the amount of AC power applied to an AC etchant plasma while a workpiece is being etched into a desired shape.

Appellant additionally argues that the limitations of the claims were not contemplated by Chao et al. as demonstrated by several steps included in Chao et al. that are not included in the claimed invention. In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., the anisotropic etch used to etch the trench and which produces sharp corners at the top and bottom of the trench, and the soft etch process, for example, in Chao et al.) are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Appellant argues that Chao et al. does not disclose a gradual increase or decrease in the power during etching but rather teaches that increasing or decreasing the source power increases or decreases the rounding at the bottom corners. However, the examiner respectfully submits that this does not take away from the fact that this would have taught to one of ordinary skill in the art at the time the invention was made to gradually increase or decrease the source power during processing in order to increase or decrease the rounding at the bottom corners of the trench and therefore form a more or less rounded profile as shown in Chao et al. (for example, see figs. 4D-4E).

Appellant additionally argues that many of the dependent claims are also not disclosed by Chao et al., specifically, claims related to the gradual change of the power. However, concerning the specific time period to which the power remains at constant wattage and the amount the power is changed, it would have been obvious to one of ordinary skill in the art at the time the invention was made to determine through routine experimentation the optimum amount of time at which the power should remain constant and the optimum amount the power is changed, based upon a variety of factors including the desired rounded/shape profile of the trench and such limitations would not lend patentability to the instant application absent a showing of unexpected results.

Concerning appellant's argument with respect to the rejection under 35 USC 112, first paragraph, and the rejection under 35 USC 103 using the Bhardwaj et al. reference, the portion of the reply brief

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addressing these issues has been entered and considered. The application has been forwarded to the Board of Patent Appeals and Interferences for decision on the appeal.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

This examiner's answer contains a new ground of rejection set forth in section (9) above. Accordingly, appellant must within **TWO MONTHS** from the date of this answer exercise one of the following two options to avoid *sua sponte dismissal of the appeal* as to the claims subject to the new ground of rejection:

(1) **Reopen prosecution.** Request that prosecution be reopened before the primary examiner by filing a reply under 37 CFR 1.111 with or without amendment, affidavit or other evidence. Any amendment, affidavit or other evidence must be relevant to the new grounds of rejection. A request that complies with 37 CFR 41.39(b)(1) will be entered and considered. Any request that prosecution be reopened will be treated as a request to withdraw the appeal.

(2) **Maintain appeal.** Request that the appeal be maintained by filing a reply brief as set forth in 37 CFR 41.41. Such a reply brief must address each new ground of rejection as set forth in 37 CFR 41.37(c)(1)(vii) and should be in compliance with the other requirements of 37 CFR 41.37(c). If a reply brief filed pursuant to 37 CFR 41.39(b)(2) is accompanied by any amendment, affidavit or other evidence, it shall be treated as a request that prosecution be reopened before the primary examiner under 37 CFR 41.39(b)(1).

Extensions of time under 37 CFR 1.136(a) are not applicable to the TWO MONTH time period set forth above. See 37 CFR 1.136(b) for extensions of time to reply for patent applications and 37 CFR 1.550(c) for extensions of time to reply for ex parte reexamination proceedings.

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Respectfully submitted,

/Luz L. Alejandro/

A Technology Center Director or designee must personally approve the new ground(s) of rejection set forth in section (9) above by signing below:

/Gregory L Mills/

Supervisory Patent Examiner, Art Unit 1700

Conferees:

/Gregory L Mills/

Supervisory Patent Examiner, Art Unit 1700

/Parviz Hassanzadeh/

Supervisory Patent Examiner, Art Unit 1792